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Original Research Article

Diagnostic Accuracy of Transvaginal Sonography Compared with Hysteroscopy in Evaluation of Abnormal Uterine Bleeding: A Comparative Study

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Abstract:

Background: Abnormal uterine bleeding is a frequent gynaecological complaint across reproductive, perimenopausal, and postmenopausal age groups. Transvaginal sonography is commonly used as the first-line imaging tool, while hysteroscopy allows direct visualization of the uterine cavity. Their comparative diagnostic yield remains clinically important, particularly where access, cost, and patient acceptability influence investigation pathways.

Objective: To compare the diagnostic accuracy of transvaginal sonography and hysteroscopy in women presenting with abnormal uterine bleeding, using final histopathology as the reference standard.

Methods: This comparative diagnostic accuracy study included 130 women with abnormal uterine bleeding who underwent transvaginal sonography, hysteroscopy, and histopathological assessment at Maharaja Krishna Chandra Gajapati (MKCG) Medical College, Berhampur, Odisha. The study was conducted over 18 months from January 2024 to June 2025. Diagnostic findings on transvaginal sonography and hysteroscopy were compared against final histopathology. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated.

Results: The mean age was 45.8 ± 8.2 years. Premenopausal, perimenopausal, and postmenopausal women constituted 48 (36.9%), 38 (29.2%), and 44 (33.8%), respectively. Histopathology showed polyp in 43 (33.1%), normal endometrium in 43 (33.1%), fibroid in 16 (12.3%), hyperplasia in 16 (12.3%), atrophy in 6 (4.6%), and cancer in 6 (4.6%). TVS showed sensitivity 81.6%, specificity 74.4%, PPV 86.6%, NPV 66.7%, and accuracy 79.2%. Hysteroscopy showed sensitivity 100.0%, specificity 88.4%, PPV 94.6%, NPV 100.0%, and accuracy 96.2%. Correct classification was significantly higher with hysteroscopy than TVS (McNemar χ^2=20.045, $p<0.001$).

Conclusion: Hysteroscopy demonstrated higher diagnostic accuracy than transvaginal sonography for evaluation of abnormal uterine bleeding. TVS remains a useful first-line, non-invasive screening tool, but hysteroscopy provides superior confirmation, especially for focal intrauterine lesions and postmenopausal endometrial pathology.

Keywords: Abnormal Uterine Bleeding, Transvaginal Sonography, Hysteroscopy, Diagnostic Accuracy, Endometrial Polyp, Histopathology.

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Introduction

Abnormal uterine bleeding is one of the most common reasons for gynaecological consultation, yet the term hides a wide clinical spectrum. In one woman, the concern may be heavy cyclic bleeding interfering with daily life. In another, it may be postmenopausal bleeding, where the clinician's first obligation is to exclude premalignant or malignant endometrial pathology. The FIGO PALM-COEIN system helped standardize the language of AUB by separating structural causes, such as polyps, adenomyosis, leiomyoma, malignancy and hyperplasia, from non-structural causes.[1]

Standardized terminology is useful, but it does not solve the day-to-day diagnostic question: which

investigation should be used first, and when is a more definitive cavity assessment needed? ACOG guidance on reproductive-age AUB supports a structured evaluation that considers age, bleeding pattern, risk factors, and imaging or sampling where indicated.[2] NICE guidance for heavy menstrual bleeding similarly stresses that the choice between ultrasound and hysteroscopy should be shaped by clinical suspicion, especially when submucosal fibroid, polyp, or endometrial pathology is likely.[3]

Transvaginal sonography is attractive because it is non-invasive, relatively affordable, widely available, and familiar in Indian outpatient practice. It gives information about uterine size, myometrium, adnexa, endometrial thickness, and sometimes focal intracavitary abnormalities. In postmenopausal bleeding, TVS also has a recognized role in triage using endometrial thickness thresholds, although persistent or recurrent bleeding still warrants further evaluation even when ultrasound is reassuring.[4]

Hysteroscopy occupies a different diagnostic space. It allows direct visualization of the endocervical canal and uterine cavity, and it can guide targeted biopsy or operative treatment when a lesion is seen. Clinical guidelines therefore place TVS as a first-line imaging test in many women, while hysteroscopy becomes especially relevant when focal pathology is suspected, when imaging is equivocal, or when symptoms persist despite conservative management.[5]

The tension is familiar in busy Indian gynaecology units. TVS is easier to organize and less invasive, but small polyps, focal hyperplasia, and submucous fibroids can be missed or misclassified. Hysteroscopy is more definitive, but it requires infrastructure, procedural time, and patient counselling. Earlier comparative studies have generally shown that hysteroscopy performs better for intracavitary lesions, while TVS remains useful as an initial filter.[6]

The present study was undertaken to compare the diagnostic accuracy of transvaginal sonography and hysteroscopy in women presenting with abnormal uterine bleeding, using final histopathology as the reference standard.

Materials and Methods

Study Design and Setting: This was a comparative diagnostic accuracy study conducted in the Department of Obstetrics and Gynaecology at Maharaja Krishna Chandra Gajapati (MKCG) Medical College, Berhampur, Odisha. The study period was 18 months, from January 2024 to June 2025.

Study Population: A total of 130 women presenting with abnormal uterine bleeding were included. The cohort comprised premenopausal, perimenopausal, and postmenopausal women with symptoms including menorrhagia, metrorrhagia, and postmenopausal bleeding.

Diagnostic Assessment: All participants underwent transvaginal sonography followed by hysteroscopic evaluation. The diagnostic categories recorded on TVS included no lesion, endometrial polyp, submucous fibroid, endometrial hyperplasia, endometrial atrophy, and suspicious endometrial malignancy. Hysteroscopic categories included no lesion, polyp, submucous fibroid, hyperplasia, atrophy, and cancer.

Reference Standard: Final histopathological diagnosis was used as the reference standard for calculation of diagnostic performance. Histopathological categories included normal endometrium, polyp, fibroid, hyperplasia, atrophy, and cancer.

Outcome Measures: The primary outcome was diagnostic accuracy of TVS and hysteroscopy compared with final histopathology. Secondary descriptive outcomes included distribution of menstrual status, symptom pattern, TVS diagnosis, hysteroscopic diagnosis, and final histopathological diagnosis.

Statistical Analysis: Continuous variables were summarized as mean and standard deviation. Categorical variables were expressed as frequency and percentage. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated for both TVS and hysteroscopy. McNemar testing was used to compare paired correct classification by the two modalities. A p-value below 0.05 was considered statistically significant.

Results

A total of 130 women with abnormal uterine bleeding were evaluated. The mean age was 45.8 ± 8.2 years, with an age range of 32–62 years. Premenopausal women constituted 48 (36.9%), followed by postmenopausal women 44 (33.8%) and perimenopausal women 38 (29.2%). Menorrhagia was the most frequent symptom, observed in 54 (41.5%), followed by postmenopausal bleeding in 44 (33.8%) and metrorrhagia in 32 (24.6%). These baseline features are summarized in Table 1 and Figure 1.

Table 1: Baseline clinical profile of women with abnormal uterine bleeding (n=130)

Variable	n (%) / Mean ± SD	Range
Age (years)	45.8 ± 8.2	32–62
Menstrual status: Premenopausal	48 (36.9%)	—
Menstrual status: Perimenopausal	38 (29.2%)	—
Menstrual status: Postmenopausal	44 (33.8%)	—
Symptom: Menorrhagia	54 (41.5%)	—
Symptom: Metrorrhagia	32 (24.6%)	—
Symptom: Postmenopausal bleeding	44 (33.8%)	—
Values are presented as mean ± SD or n (%)		

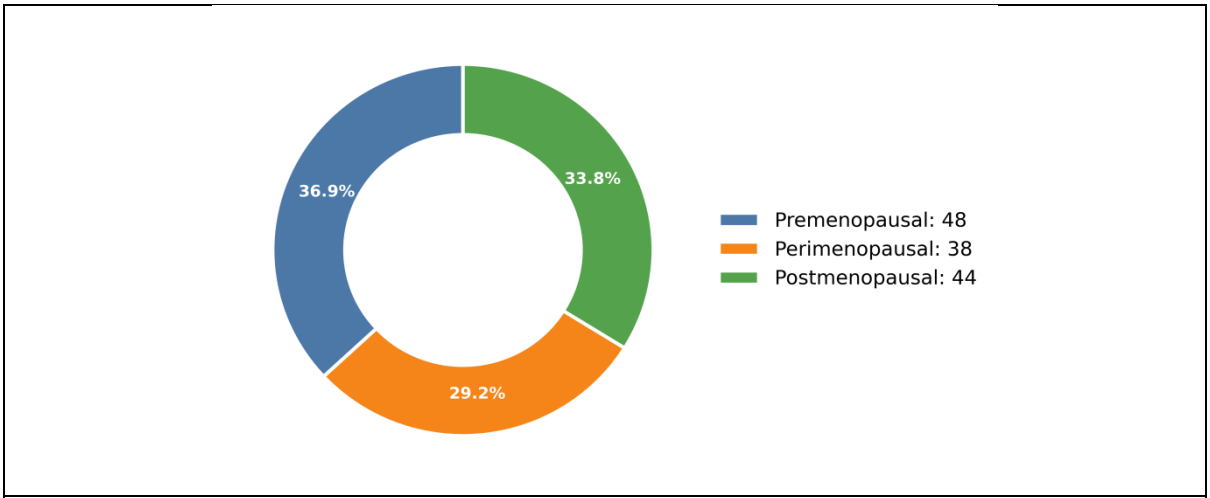

Figure 1: Menstrual status distribution of the study cohort

Donut chart shows the proportion and count of women in each menstrual-status group.

Final histopathology revealed endometrial polyp in 43 (33.1%) women and normal endometrium in 43 (33.1%). Submucous fibroid and endometrial hyperplasia were each identified in 16 (12.3%) women. Endometrial atrophy and cancer were each seen in 6 (4.6%) women. The comparative distribution of TVS diagnosis, hysteroscopic diagnosis, and final histopathology is shown in Table 2, while the histopathological spectrum is displayed in Figure 2.

Table 2: Diagnostic findings by TVS, hysteroscopy and final histopathology (n=130)

Diagnostic category	TVS diagnosis n (%)	Hysteroscopy diagnosis n (%)	Final histopathology n (%)
No lesion / normal	48 (36.9%)	38 (29.2%)	43 (33.1%)
Endometrial polyp	27 (20.8%)	43 (33.1%)	43 (33.1%)
Submucous fibroid	22 (16.9%)	16 (12.3%)	16 (12.3%)
Endometrial hyperplasia	27 (20.8%)	16 (12.3%)	16 (12.3%)
Endometrial atrophy	4 (3.1%)	11 (8.5%)	6 (4.6%)
Endometrial cancer	2 (1.5%)	6 (4.6%)	6 (4.6%)
TVS: transvaginal sonography			

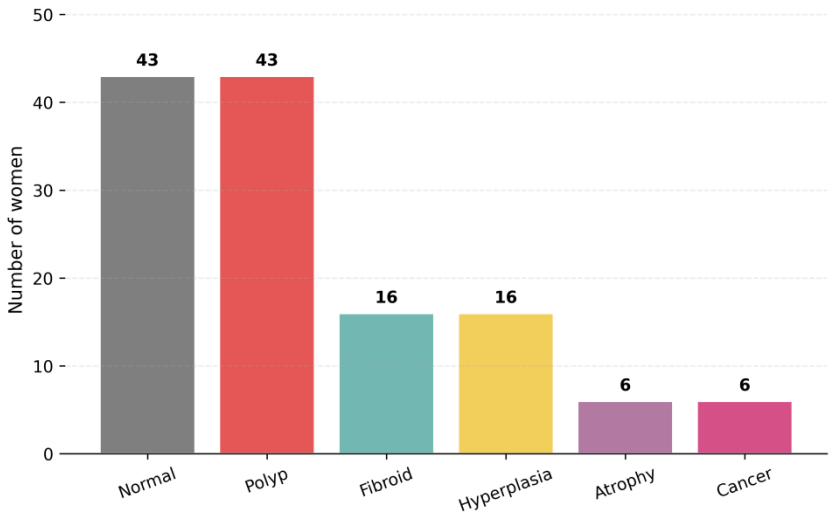

Figure 2: Final histopathological diagnosis among women with abnormal uterine bleeding

Vertical bar chart displays histopathological categories; values are shown above bars.

Compared with final histopathology, TVS produced 71 true-positive, 32 true-negative, 11 false-positive, and 16 false-negative classifications. Hysteroscopy produced 87 true-positive, 38 true-negative, 5 false-positive, and 0 false-negative classifications. These diagnostic classifications are presented in Table 3 and visualized in Figure 4.

Table 3: Diagnostic classification of TVS and hysteroscopy against final histopathology

Diagnostic classification	TVS n (%)	Hysteroscopy n (%)
True positive	71 (54.6%)	87 (66.9%)
True negative	32 (24.6%)	38 (29.2%)
False positive	11 (8.5%)	5 (3.8%)
False negative	16 (12.3%)	0 (0.0%)
Final histopathology was used as the reference standard for all diagnostic classifications		

The overall performance profile favoured hysteroscopy. TVS showed sensitivity 81.6%, specificity 74.4%, PPV 86.6%, NPV 66.7%, and accuracy 79.2%. Hysteroscopy showed sensitivity 100.0%, specificity 88.4%, PPV 94.6%, NPV 100.0%, and accuracy 96.2%. Correct classification was significantly higher with hysteroscopy than TVS on paired comparison (McNemar χ^2=20.045, p<0.001). The performance indices are summarized in Table 4 and Figure 3.

Parameter	TVS	Hysteroscopy
Sensitivity	81.6% (71/87)	100.0% (87/87)
Specificity	74.4% (32/43)	88.4% (38/43)
Positive predictive value	86.6% (71/82)	94.6% (87/92)
Negative predictive value	66.7% (32/48)	100.0% (38/38)
Accuracy	79.2% (103/130)	96.2% (125/130)
McNemar comparison of correct classification	χ^2=20.045; p<0.001	χ^2=20.045; p<0.001
PPV: positive predictive value; NPV: negative predictive value		

Table 4: Diagnostic performance of TVS and hysteroscopy compared with final histopathology

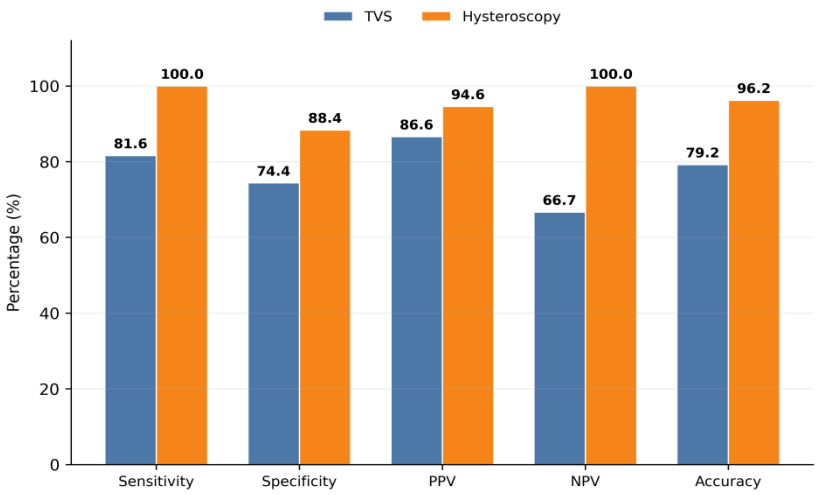

Figure 3: Comparative diagnostic performance of TVS and hysteroscopy

Grouped bars show percentage estimates for sensitivity, specificity, PPV, NPV, and accuracy.

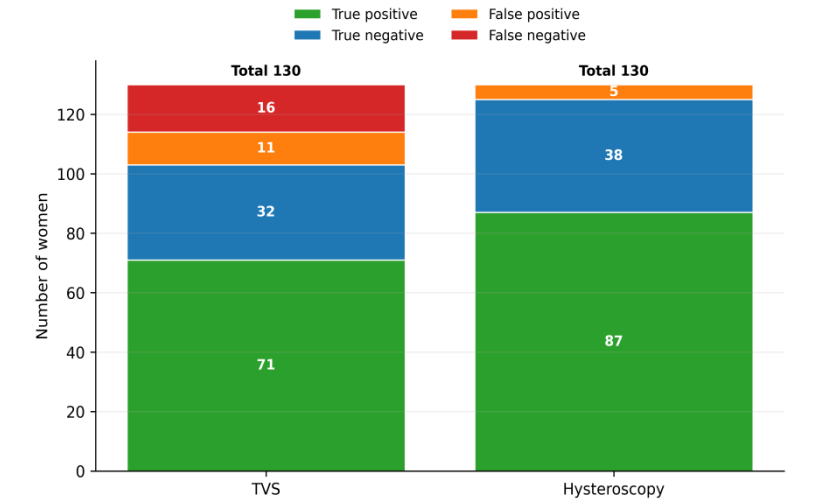

Figure 4: Diagnostic classification pattern for TVS and hysteroscopy

Stacked bars show true-positive, true-negative, false-positive, and false-negative classifications for each modality.

Discussion

In this comparative diagnostic accuracy study, hysteroscopy showed clearly better performance than transvaginal sonography for evaluation of abnormal uterine bleeding. Hysteroscopy achieved 96.2% accuracy with no false-negative classifications, whereas TVS had an accuracy of 79.2% and missed 16 histopathologically confirmed abnormalities. The finding is clinically meaningful because missed lesions in routine practice may delay targeted biopsy or definitive treatment.

Towbin et al. reported that office hysteroscopy was superior to TVS in detecting intracavitary pathology among women with excessive uterine bleeding, a pattern that is in line with the present findings.[7] Emanuel et al. similarly found that TVS may be useful for excluding some endometrial and intrauterine abnormalities, yet diagnostic hysteroscopy had practical value when direct cavity visualization was needed.[8]

The present study also resembles the clinical message from de Vries et al., who showed that techniques that better outline the uterine cavity improve detection of intracavitary abnormalities when compared with TVS alone.[9] Although that study included saline infusion sonography, the underlying point remains relevant: standard TVS can underestimate focal pathology because it views the cavity indirectly.

Hysteroscopy performed particularly well in the present cohort because it detected all histopathology-positive cases, including polyps, fibroids, hyperplasia, atrophy, and cancer. This does not mean hysteroscopy should replace TVS for every woman with AUB. Rather, it confirms that hysteroscopy is the stronger confirmatory test when

focal pathology is suspected, bleeding persists, or postmenopausal bleeding raises concern. Systematic evidence from van Dongen et al. supports the accuracy and feasibility of diagnostic hysteroscopy in AUB, especially for intrauterine abnormalities.[10]

The meta-analysis by Gkrozou et al. also concluded that hysteroscopy has high diagnostic accuracy for endometrial cancer, polyps, and submucous myomas, while its accuracy for hyperplasia is more moderate.[11] This distinction matters. Hysteroscopy shows morphology; histopathology still decides the tissue diagnosis. Therefore, hysteroscopy and biopsy should be seen as complementary, not competing, steps in evaluation of suspicious or persistent AUB.

TVS retained value in the present study. It correctly classified 103 women and detected several structural abnormalities, including polyps, fibroids, hyperplasia, atrophy, and suspected malignant pathology. It remains especially important in Indian clinical settings where outpatient hysteroscopy may not be readily available in all institutions. A first-line, non-invasive scan can help triage women, identify obvious uterine pathology, and guide counselling before invasive testing. However, the NPV of TVS was 66.7%, which cautions against over-reassurance when symptoms persist.

Evidence on saline infusion sonohysterography also helps interpret the limitations of TVS. Kaveh et al. reported that SIS improves diagnostic accuracy for endometrial polyps compared with TVS in women with AUB.[12] Seshadri et al., in a systematic review, similarly showed high pooled sensitivity and specificity of SIS for uterine cavity abnormalities.[13] These findings explain why enhanced cavity imaging may be a useful intermediate option where hysteroscopy access is limited.

Bingol et al. compared TVS, SIS, and hysteroscopy and found that diagnostic performance varies according to the modality used and the uterine pathology being assessed.[14] Farquhar et al. also emphasized, through systematic review, that no single investigation behaves identically across all AUB presentations.[15] Thus, the diagnostic pathway should not be mechanical. Age, bleeding pattern, risk factors, ultrasound findings, and availability of hysteroscopy all matter.

In the present cohort, endometrial polyp and normal histology were the most frequent final findings, each accounting for 33.1% of women. Submucous fibroid and hyperplasia each accounted for 12.3%, while cancer was identified in 4.6%. This distribution is plausible for a hospital-based AUB population that includes postmenopausal bleeding. It also highlights why tissue confirmation remains essential, because the same symptom - bleeding - may represent benign focal disease, hormonal endometrial change, premalignant pathology, or malignancy.

Indian gynaecology practice often has to balance ideal diagnostic sequencing with practical realities. TVS is accessible, acceptable, and relatively inexpensive. Hysteroscopy is more definitive but requires trained personnel, equipment, scheduling, and patient preparation. The most pragmatic interpretation of this study is therefore not that every woman should undergo hysteroscopy first. Instead, women with persistent symptoms, postmenopausal bleeding, suspected intracavitary lesions, thickened or heterogeneous endometrium, or discordant clinical and ultrasound findings should move promptly to hysteroscopy with directed biopsy.

The study has limitations. It was hospital-based and may over-represent women with more symptomatic or higher-risk bleeding patterns. The sample size was modest for subgroup-level estimates, especially for endometrial cancer and atrophy. Lesion-specific sensitivity was not calculated separately for every pathology because some categories had small counts. Operator expertise, image quality, and hysteroscopic technique were not evaluated separately. Even so, the study provides a clinically usable message: TVS is a reasonable first-line assessment, but hysteroscopy offers substantially higher diagnostic certainty when histopathological confirmation is required.

Overall, the results support a stepwise but vigilant diagnostic approach. TVS can begin the evaluation. Hysteroscopy should close the uncertainty.

Conclusion

Hysteroscopy demonstrated higher diagnostic accuracy than transvaginal sonography in the evaluation of abnormal uterine bleeding when compared with final histopathology. TVS remains useful as a first-line, non-invasive screening modality, particularly for initial triage and assessment of obvious structural pathology. However, hysteroscopy provides superior confirmation and should be considered when TVS is normal despite persistent symptoms, when focal intrauterine pathology is suspected, or when postmenopausal bleeding requires definitive evaluation.

Source of Funding

Nil.

Conflict of Interest

None declared.

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